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Effects Of Cocktail Enzymes Supplementation on Performance and Gut Morphology of Arbor-Acre Broilers Fed Low Density Diets Based on Corn-Soyabean Meal

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ABSTRACT

The effect of maxigrain cocktail enzyme on performance and gut morphology were investigated in a 42-day feeding trial. A total of 240 one-week-old arbor-acre broiler chickens were fed the following diets at the finisher phase: Treatment 1 (T1): 21% CP + 3000kcal/kgME - Enzyme, Treatment 2 (T2): 21% CP + 3000 kcal/kgME + Enzyme, Treatment 3 (T3): 21% CP + 2600 kcal/kgME - Enzyme, Treatment 4 (T4): 21% CP + 2600 kcal/kgME + Enzyme, Treatment 5 (T5): 17% CP + 3000 kcal/kgME - Enzyme, Treatment 6 (T6): 17% CP + 3000 kcal/kgME + Enzyme. The experimental design was a completely randomized design. The birds were randomly assigned to six (6) dietary treatments of 4 replicates each and 10 birds per replicate. The birds were fed *ad-libitum* and were weighed on a weekly basis to determine their growth performance. On day 42, four birds were slaughtered and sections of the duodenum, ileum and jejunum (1cm) were removed for gut histomorphology. Maxigrain enzyme supplementation significantly increased the performance (average body weight again (ABWG), total average feed intake (TAFI)) especially with birds on treatment 1 (T1) and treatment 2 (T2). Although, birds fed treatments 4 (T4) compared favourably with those on treatment 1 (T1). Enzyme supplementation had significant ($P<0.05$) effect on the villus height (VH), crypt depth (CD), villus width (VD), muscular width (WD) and the villus to crypt depth ratio (V:CD) of the birds duodenum, jejunum and ileum sections across the treatments. These dietary supplement had significant ($P<0.05$) effect on the villus height (1629.00µm - 5620.00µm (duodenum), 1731µm - 6851µm (jejunum), 1149µm - 5061µm (ileum)), crypt depth (155.00µm - 641.10µm (duodenum), 214.40µm - 873.60µm (jejunum), 158.60µm - 751.10µm (ileum)), villus width (148.40µm - 426.30µm (duodenum), 151.00µm - 538.10µm (jejunum), 131.60µm-675.50µm (ileum)) and muscular width (421.70µm -1347.30µm (duodenum), 445.30µm - 1347.30µm (jejunum), 333.30µm - 1584.60µm (ileum)) and the villus to crypt depth ratio (7.90 - 12.03 (duodenum), 7.84 - 9.83 (jejunum), 6.82 - 11.21 (ileum)). Effect of enzyme inclusion better increased the histomorphometric parameters measured of bird's duodenum, jejunum and ileum particularly of birds on T4. The villus to crypt depth ratio of bird's duodenum section fed T2 and T6 were increased by enzyme supplementation however, there were decreases in the jejunum and ileum sections of birds fed T2 and T4. Maxigrain cocktail enzyme resulted in improved growth performance and gut morphology of broiler birds fed low energy diets, giving a cost-effective nutritional strategy for profitable broiler production.

Keywords: Cocktail enzyme, Performance, Gut morphology, Arbor-acreBroilers

INTRODUCTION

Broiler feed is based primarily on corn and soyabean meal (SBM). Corn is the predominant source of energy in feed because of its abundance while SBM is a valuable protein source in broiler diets because of its high protein content and well balance amino acid profile (Abudabos, 2012). It was reported that they are incompletely digested by poultry due to the presence of non-starch polysaccharides (NSPs) which is considered as anti-nutritional factor (Pack and Bedford, 1997). Neither corn nor soyabean meal is regarded as viscous feedstuffs even though they do contain appreciable amounts of non-starch polysaccharides (NSP's). Corn contains approximately 0.9% soluble NSP and 6% insoluble NSP, whereas soyabean meal contains approximately 6% soluble NSP and 18- 21% insoluble NSP (Bach Knudsen, 1997). Noy and Sklan (1994) reported that ileal digestibility of corn starch rarely exceeds 85% in broilers between 4 and 21 days of age, indicating opportunities to further improve the digestibility of resistant starch in the jejunum and ileum through amylase supplementation.

There is considerable evidence that negative effects of NSP in poultry diets are related to the gut microflora of broilers (Annison and Choct, 1991).

Diet composition may produce microscopic alterations in the intestinal mucosa (Yamauchi, 2002) and it is possible that the change in morphology of the gastrointestinal tract (GIT) may be associated with dietary NSP's levels. It has been proposed that the NSP-degrading enzymes reduce digesta viscosity in the small intestine, and result in improvements in nutrient absorption.

Some researchers showed that excess supplementation of enzyme complex had no effect on performance or even inhibited endogenous enzyme secretion and destroyed small intestine structure (Ijiet *al*., 2001; Ai *et al*., 2004). The rich bacterial community that make up the gut micro flora play animportant role for the host through changes in the morphology of gut, nutrition, pathogenesis of enteric diseases, immune response and alterations in colonization resistance. The shift in composition of this microflora results in production and efficiency losses often in the absence of any clinical signs (Dharne, 2008). Useful microbes (commensal bacteria) in gut play a positive role in controlling the gut flora and stimulate the development of the gut wall. Hence, microbial balance of gut is utmost important in maintaining gut integrity. The significance of gut microflora to the nutrition of chickens is not well documented. Excessive fermentation in the small intestine may interfere with the normal physiological process of nutrient absorption. Elevated levels of intact soluble NSPS detrimentally increased the activity of fermentative microorganism in the small intestine (Choctet *al*., 1996). Xylanasesupplementation largely eliminated fermentation in the small intestine and improves the performance of the birds. A sudden change in the gut ecology (from an aerobic or facultative environment to a strictly anaerobic one) may induce gastrointestinal stress and severely affect the normal the physiological processes (Choct,2007).

The objectives of the present study was to investigate the effects of cocktail enzyme supplementation ongrowth performance and gut morphologyofarbor-acre broilers fed corn-soyabean meal based dietsthat differ in energy and protein content (low density diets) with maxigrain cocktail enzyme as additives.

MATERIALS AND METHODS

EXPERIMENTAL BIRDS AND DESIGN

A total of 240 one-week-old (Arbor-acre strains) were used for this study. The experimental design adopted for this research study was Completely Randomized Design (CRD). The birdswere randomly assigned to six (6) dietary treatments of four (4) replicates each and ten (10) birds per replicate.

EXPERIMENTAL DIETS AND ENZYMES

The cocktail enzymes used in this research study were composed of the following enzymes: Cellulase, Xylanase, β-Glucanase, and Phytase, containing 10,000I.U, 2001.U, 10,000I.U and 2500FTU. The test ingredients, cocktail enzyme with the brand name maxigrain enzyme was procured from a reliable outlet while the other feed ingredients were purchased from a reputable feed mill. Six diets were formulated and each diet was supplemented with or without maxigrain cocktail enzyme. Recommended dosage on the maxigrain is 100g/T of feed.

Dietary Treatment 1: Control diet (3000 kcalME/kg, 23% CP) without Maxigrain enzyme, normal levels of nutrient density (ME and CP).

Dietary Treatment 2: Diet 1 + 0.01% Maxigrain enzyme.

Dietary Treatment 3: low nutrient density (ME, 2700 kcalME/kg, 23% CP) without cocktail enzyme, (normal ME and low CP) diets.

Dietary Treatment 4: Diet 3 + 0.01% Maxigrain enzyme.

Dietary Treatment 5: low nutrient density (3000 kcalME/kg, 17% CP) without cocktail enzyme, (normal ME and low CP) diet.

Dietary Treatment 6: Diet 5 + 0.01% Maxigrain enzyme

ME- Metabolizable Energy, CP- Crude protein

PERFORMANCE PARAMETERS

Data were collected on weekly basis. The following data were collected; Feed intake, Initial weight gain, Final weight gain, Body weight (Final weight gain – Initial weight gain) and Feed conversion ratio

GUT MORPHOLOGY

On day 42, four birds were selected from each replicate at random and slaughtered after a period of fasting (16 hours). Examinations of intestinal morphology were carried out according to the method of Ijiet *al*., (2001).

STATISTICAL ANALYSIS

The data obtained were subjected to simple analysis of variance (ANOVA) using the General Linear Model procedure of the SAS, (2009). Means of various treatment groups were separated with Duncan's Multiple Range Test (DMRT). The significant differences were analysed at 5% level ($p<0.05$) level of significant.

RESULTS

Broiler Performance Characteristics at the Finisher Phase

Significant ($P<0.05$) variations were observed in the total average feed intake (TAFI) of birds across all dietary treatments. Birds on treatment 2 recorded the highest mean value of 3627.10g/bird which was significantly ($P<0.05$) higher when compared with

birds on treatments 1 (3381.90g/bird), 3 (3345.90g/bird), 5 (2624.10g/bird) and 6 (2579.40g/bird) respectively. No significant (P>0.05) variations were observed among the birds on treatments 1(3381.90g/bird), 2(3627.10g/bird) and 3(3345.90g/bird) when compared with birds on treatment 4(3435.90g/bird). The average final body weight gain (AFBW) of broilers fed treatments 5(1147.50g/bird) and 6(1150.00g/bird) indicated significant(P<0.05) variation. The mean values of birds on dietary treatments 1 (1734.17g/bird), 2 (1870.83g/bird), 3 (1620.00g/bird) and 4 (1677.50g/bird) varied significantly (P<0.05) from treatments 5 (1147.50g/bird) and 6 (1150.00g/bird).

Gut Morphology (Histomorphometric) of Arbor-acre Broiler Chickens fed Maxigrain Exogenous Cocktail Enzyme Supplemented Diets at the Finisher Phase.

Table 1: Percentage Composition of Experimental Finisher Diets

Ingredients	T1	T2	T3	T4	T5	T6
Maize	58.60	58.60	47.50	47.50	56.68	56.68
Soyabean	35.00	35.00	30.00	30.00	17.90	17.90
Wheat offal	0.00	0.00	16.10	16.10	18.02	18.02
Soya oil	3.00	3.00	3.00	3.00	4.00	4.00
Limestone	1.75	1.75	1.75	1.75	1.75	1.75
DCP	1.00	1.00	1.00	1.00	1.00	1.00
BP	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Methinione	0.15	0.15	0.15	0.15	0.15	0.15
Enzyme	0.00	0.01	0.00	0.01	0.00	0.01
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00
Calculated values						
ME (Kcal/Kg)	3065.80	3065.80	2612.57	2612.57	3003.33	3003.33
CP (%)	21.96	21.96	21.32	21.32	16.64	16.64
CF (%)	3.45	3.45	4.27	4.27	3.83	3.83
Ca (%)	0.95	0.95	0.95	0.95	0.93	0.93
NPP (%)	0.38	0.38	0.40	0.40	0.35	0.35
Met (%)	0.46	0.46	0.45	0.45	0.40	0.40
Lys (%)	1.13	1.13	1.10	1.10	0.81	0.81
Ca:NPP (%)	2.47	2.47	2.36	2.37	2.65	2.65

ME- Metabolizable energy, CP- Crude Protein, CF- Crude Fibre, Met- Methionine, NPP- Non-Phytate Phosphorus, Ca- Calcium, Lys- Lysine, DCP-*DiCalcium Phosphate*, *BP- Broiler Premix*,Ca:NPP-Calcium: Non-Phytate Phosphorus

Table 2: Performance of Arbor-acre Broiler Chickens fed Cocktail Enzyme Supplemented Diets at the Finisher Phase.

Parameters Measured	Dietary Treatments						SEM	p-values
	T1	T2	T3	T4	T5	T6		
TAFI(g/bird)	3381.90^{b}	3627.10^{a}	3345.90^{b}	3435.90^{ab}	2624.10^{c}	2579.40^{c}	73.62	< 0.001
AIBW(g/bird)	113.75^{dc}	132.50^{ab}	132.50^{ab}	142.50^{a}	123.75^{bc}	105.00^{d}	4.43	<0.001
AFBW(g/bird)	1734.17^{b}	1870.83^{a}	1620.00^{b}	1677.50^{b}	1147.50^{c}	1150.00^{c}	40.52	<0.001
ABWG(g/bird)	1620.42^{ab}	1738.33^{a}	1487.50^{c}	1535.00^{bc}	1023.75^{d}	1045.00^{d}	40.64	<0.001
FCR	2.09^{c}	2.09^{c}	2.25^{bc}	2.24^{bc}	2.58^{a}	2.48^{ab}	0.08	0.0017

a, b, c, d means with different superscripts in the same row are significantly (P<0.05)different

SEM means Standard error of mean, TAFI- Total Average Feed Intake, AIBW-Average Initial Body Weight, AFBW- Average Final Body Weight, ABWG- Average Body Weight Gain, FCR- Feed Conversion Ratio, T1- Treatment 1, T2- Treatment 2, T3- Treatment 3, T4- Treatment 4, T5- Treatment 5, T6- Treatment 6.

Treatment 1 (T1): 21% CP + 3000kcal/kgME - Enzyme, Treatment 2 (T2): 21% CP + 3000 kcal/kgME + Enzyme, Treatment 3 (T3): 21% CP + 2600 kcal/kgME - Enzyme, Treatment 4 (T4): 21% CP + 2600 kcal/kgME + Enzyme, Treatment 5 (T5): 17% CP + 3000 kcal/kgME - Enzyme, Treatment 6 (T6): 17% CP + 3000 kcal/kgME + Enzyme

Duodenum section

The result of the gut morphometric attributes of duodenum section of broiler chickens fed corn-

soyabean meal maxigrain cocktail enzyme supplemented diets are shown on table 3.

There was variations (P<0.05) in the villus height of the duodenum of the birds across the treatments. Birds on treatment 6 recorded numerically highest mean value 5620.00µm which was significantly (P<0.05) higher when compared with the mean values of birds on treatments 1 (1730.09µm), 2 (1865.00µm), 3 (1629.00µm) and 5(1475.00µm) respectively. However, the mean value of birds on treatments 1(1730.09µm), 2 (1865.00µm), 3 (1629.00µm) and 5(1475.00µm) were significantly (P>0.05) alike when compared with birds on treatment 4 (5186.00µm). Significant variations (P<0.05) were observed in the crypt depth duodenum of birds across the dietary treatments. Birds on treatment 4 had the highest mean value (641.40µm), which was significantly (P<0.05) higher when compared with the values of birds on treatments 1(203.60µm), 2(155.00µm), 3(193.10µm) and 5(186.70µm) respectively. No significant (P>0.05) variations were observed among the birds on treatments 1(203.60µm) and 3(193.10µm) respectively.

There were no significant (P>0.05) differences observed among the villus width of broiler's duodenum on treatments 1(178.30µm).3(175.70µm) and 5(184.40µm), but broilers on treatment 6 had the highest mean value of 426.30 µm which was not significantly (P>0.05) different from the mean value (424.10µm) of birds on treatment 4. No significant (P>0.05) differences were observed among the muscular width of bird's duodenum on treatments 1(468.00µm), 2(540.20µm) and 5(421.70µm), but broilers on treatment 3had the highest mean value of 1347.30µmwhich was not significantly (P>0.05) different from birds on treatment 4(1152.10µm). Birds on treatment 6 recorded the mean value of 904.70µm.The ratio of villus height to crypt depth of bird's duodenum of treatment1 (8.50), 3(8.44), 4(8.09) and 5(7.90) were significantly alike, however birds on treatment 2 recorded the highest mean value of 12.00 while treatment 6 had a mean value of (10.01).

Table 3: Duodenum Parameters (Histomorphology) of Arbor-acre Broiler Chickens Fed Exogenous Cocktail Enzyme Supplemented Diets at the Finisher Phase.

Parameters measured	Dietary Treatments						
	T1	T2	T3	T4	T5	T6	SEM
VH (µm)	1730.09^{b}	1865.00^{b}	1629.00^{b}	5186.00^{ab}	1475.00^{b}	5620.00^{a}	1191.91
CD (µm)	203.60^{c}	155.00^{e}	193.10^{c}	641.10^{a}	186.70^{d}	561.20^{b}	161.96
VW (µm)	178.30^{b}	148.40^{c}	175.70^{b}	424.10^{a}	184.40^{b}	426.30^{a}	89.78
MW (µm)	468.00^{c}	540.20^{c}	1347.3^{a}	1152.10^{a}	421.70^{c}	904.70^{b}	254.54
VH/CD	8.50	12.03	8.44	8.09	7.90	10.01	-

a, b, c, d, e Means with differing superscript in the same row are significantly (P<0.05) different.
SEM means Standard error of mean. VH- Villus height, CD- Crypt depth, VW- Villus width, MW- Muscular width, Treatment 1 (T1): 21% CP + 3000kcal/kgME - Enzyme. Treatment 2(T2): 21% CP + 3000 kcal/kgME + Enzyme. Treatment 3 (T3): 21% CP + 2600 kcal/kgME - Enzyme. Treatment 4 (T4): 21% CP + 2600 kcal/kgME + Enzyme. Treatment 5 (T5): 17% CP + 3000 kcal/kgME - Enzyme. Treatment 6 (T6): 17% CP + 3000 kcal/kgME + Enzyme

Jejunum Section

The results of the jejunum section of broiler chickens fed corn-soyabean meal diets supplemented with maxigrain cocktail enzymes are shown on table 4.

Enzyme supplementation increased the villus height jejunum section of birds on treatment 4which recorded the highest numerically mean value 6851.00µm which was significantly (P<0.05) higher when compared with the values of birds on the other treatments (T1-2107.00µm, T2-1918.00µm, T3-1731µm,T5-3672µm and T6-3542.00µm). Significant (P<0.05) variations were observed in the crypt depth jejunum of birds across the dietary treatments. Birds on treatment 4 had the highest mean value of 873.60µm which differ significantly (P<0.05) from birds on treatments 1(214.40µm), 2(219.20µm) and 3(208.60µm) while Treatment 3 had the lowest mean value 208.60µm.

Birds on dietary treatments 4 recorded the highest mean value (538.10µm) of villus width in their jejunum, which differed significantly (P<0.05) when compared with those on treatments 1(151.00µm), 2(154.00µm), and 3(167.90µm).On the other hand, birds fed treatment 5(302.10µm) and 6(296.40µm) were not significantly (P>0.05) different. The muscular width of broiler's jejunum were significantly (P<0.05) different across the treatments. However, broilers fed dietary treatment 4 had numerically higher mean value of 1347.30µm while the broilers on treatment 1(472.50µm) and 3(445.30µm) did not differ significantly (P<0.05). But, there was significant (P<0.05) difference

observed in treatments 3(445.00µm), 5(670.30µm) and 6(706.10µm) respectively.

The highest villus to crypt depth ratio of bird's jejunum was observed in treatment 1(9.83) while the least value was recorded on birds in treatment 4(7.84). Birds on treatment 1(9.83µm) significantly ($P<0.05$) differ from the other treatments but no significant ($P>0.05$) variation among the birds in treatments 2(8.75µm) and 5(8.55) respectively as well as 3(8.30) and 4(7.84) in that order.

Ileum Parameters (Gut Histomorphology) of Arbor-Acre Broiler Chickens fed Dietary Exogenous Cocktail Enzyme Supplemented Diets.

The results of the gut histo-morphometric attributes of Ileum section of broiler chickens fed corn-soyabean meal maxigrain cocktail enzyme supplemented diets are shown on table 5.

Table 4: Jejunum Parameters (Gut Morphology) of Arbor-Acre Broiler Chickens fed Dietary Exogenous Cocktail Enzyme Supplemented Diets at the Finisher Phase.

Parameters measured	Dietary Treatments						
	T1	T2	T3	T4	T5	T6	SEM
VH (µm)	2107.00^{b}	1918.00^{b}	1731.00^{b}	6851.00^{a}	3672.00^{ab}	3542.00^{ab}	1154.93
CD (µm)	214.40^{c}	219.20^{c}	208.60^{c}	873.60^{a}	429.50^{b}	370.50^{b}	142.88
VW (µm)	151.00^{b}	154.00^{b}	167.90^{b}	538.10^{a}	302.10^{ab}	296.40^{ab}	78.32
MW (µm)	472.50^{e}	507.00^{d}	445.30^{e}	1347.30^{a}	670.30^{c}	706.10^{b}	297.73
VH/CD	9.83	8.75	8.30	7.84	8.55	9.56	-

a,b,c,d,e Means with differing superscript in the same row are significantly ($P>0.05$) different.
SEM means Standard error of mean. VH- Villus height, CD- Crypt depth, VW- Villus width, MW- Muscular width. Treatment 1 (T1): 21% CP + 3000kcal/kgME - Enzyme. Treatment 2 (T2): 21% CP + 3000 kcal/kgME + Enzyme. Treatment 3 (T3): 21% CP + 2600 kcal/kgME - Enzyme. Treatment 4 (T4): 21% CP + 2600 kcal/kgME + Enzyme. Treatment 5 (T5): 17% CP + 3000 kcal/kgME - Enzyme. Treatment 6 (T6): 17% CP + 3000 kcal/kgME + Enzyme.

Table 5: Ileum Parameters (Gut Morphology) of Arbo-acre Broiler Chickens fed Dietary Exogenous Cocktail Enzyme Supplemented Diets at the Finisher Phase

Parameters measured	Dietary Treatments						
	T1	T2	T3	T4	T5	T6	SEM
VH(µm)	1778.00^{b}	1149.00^{b}	1619.00^{b}	3059.00^{ab}	5061.00^{a}	3031.00^{ab}	1142.75
CD(µm)	158.60^{b}	191.00^{b}	165.20^{b}	491.00^{ab}	751.10^{a}	362.40^{ab}	153.25
VW(µm)	131.60^{b}	148.50^{b}	162.30^{b}	323.10^{ab}	675.50^{a}	344.80^{ab}	142.92
MW(µm)	466.10^{d}	763.70^{c}	334.30^{d}	1409.7^{b}	1584.6^{a}	747.00^{c}	396.21
VH/CD	11.21	6.02	9.80	6.20	6.74	8.36	-

a,b,c,dmeanswith differing superscript in the same row are significantly ($P>0.05$) different.
SEM means Standard error of mean. VH- Villus height, CD- Crypt depth, VW- Villus width, MW- Muscular width. Treatment 1 (T1): 21% CP + 3000kcal/kgME - Enzyme. Treatment 2 (T2): 21% CP + 3000 kcal/kgME + Enzyme. Treatment 3 (T3): 21% CP + 2600 kcal/kgME - Enzyme. Treatment 4 (T4): 21% CP + 2600 kcal/kgME + Enzyme. Treatment 5 (T5): 17% CP + 3000 kcal/kgME - Enzyme. Treatment 6 (T6): 17% CP + 3000 kcal/kgME + Enzyme.

There was no significant ($P>0.05$) variations in the villus height of bird's ileum on treatments1 (1778.00µm), 2(1149.00µm) and 3(1619.00µm) respectively. Treatments 4(3059.00µm) and 6(3031.00µm) were significantly alike, however, birds on treatment 5 had a significantly higher mean value of 5061.00µm.Birds on treatment 5 had the highest mean value of 751.10µm of crypt depth which was significantly ($P<0.05$) higher when compared with the values of birds on the other treatments (T1- 158.60µm, T2- 191.00µm, T3- 165.20µm, T4- 491.00µm and 6- 362.40µm). Treatments 1(158.60µm), 2(191.00µm) and 3(165.20µm) in that order were significantly alike,

also, Treatments 4(491.00µm) and 6(362.40µm) were not significantly significant (P>0.05) different.

There was no significant differences (P>0.05) recorded among the villus width of broiler's ileum on treatments 1(131.60µm), 2(148.50µm) and 3 (162.30µm), but broilers on treatment 5 had the highest mean value of 675.50µm. Significant (P>0.05) different was not recorded in birds on treatment 4(323.10µm) and 6(344.80µm). Significant (P<0.05) variations were observed among the muscular width of broiler's ileum across the dietary treatments which ranges from (445.3µm - 1584.60µm).Broilers on treatment 3had the highest mean value of 1584.60µm while there were no significant (P>0.05) differences observed among the broiler's on treatments 1(466.10µm) and 3(334.30µm) respectively as well as 2(763.70µm) and 6(747.00µm) respectively. There were significant (P<0.05)differences recorded in the villus height to crypt depth ratio of the bird's ileum in all the treatments. The mean values of the birds fed treatments 2(6.02) and 4(6.02) were significantly alike and had the least values, however treatments 3(9.80), 5(6.74) and 6(8.36) differ significantly, while treatment 1 recorded the highest mean value of 11.2.

DISCUSSION

Broilers Performance Characteristics at Finisher Phase

Enzyme supplementation of poultry diets has been reported to destroy the anti-nutritive factors in cereal by enhancing the overall digestibility of the feed and nutrient availability (Choct *et al.*, 1999) which shows in the result of this experimental study in diets supplemented with enzyme. Exogenous enzyme blends containing various combinations of amylases, proteases, xylanases, glucanase, cellulase, mannanase, and pectinase have been added to corn-soyabean meal poultry diets and found to improve bird performance (Yu and Chung, 2004; Cowieson and Adeola, 2005) and apparent metabolisable energy (Meng and Slominski, 2005; Saleh*et al.*, 2005). Zanella *et al.* (1999) demonstrated that the supplementation of low energy broiler diets with an enzyme mixture containing amylase, protease, and xylanase improved digestibility of nutrients and bird performance. Ritz *et al.*, 1995 and Gracia *et al.*, 2003 have similarly reported improved performance when carbohydrases were used. When the low energy diet was supplemented with cocktail enzymes, there was an improvement in the performance of the birds as regards the average final body weight again and the average body weight again and these weight gains were similar to the diets containing normal density diet without enzyme.

The results of growth performance of broiler birds fed corn-soyabean meal diets that are normal to low revealed that birds on the normal density level with enzyme addition responded positively to enzyme supplementation, however, those which had the low density diets (low energy-normal protein) had a high response to the enzyme as shown in the average final body weight again and average body weight gain. Likewise, enzyme increased the total average feed intake for birds which had the normal protein (23%CP2700kcalME/kg) diets while it decreases by those who received the low energy diets (17%CP 3000kcalME/kg). The improvement in feed efficiency could be explained in part by the improvement in body weight gain that occurred as a result of the enzyme supplementation. It has been reported that corn-soyameal diets supplemented with enzyme produced significant improvement in growth performance in broilers (Wyatt, 1992; Zanella*et al.*, 1999; Gracia*et al.*, 2003and Abudabos, 2010). This experimental result agrees with the report of these authors, however, it was in turn contrary to the report of Doughlas*et al.* (2000) which reported no corresponding feed efficiency improvements with enzyme.

Intestinal Morphology (Histomorphology) of Arbor-acre Broiler Chickens on Corn-Soyameal Based Diets at the Finisher Phase.

The manipulation of gut functions and microbial habitat of domestic animals with feed additives has been recognized as an important tool for improving growth performance and feed efficiency. Mucosa status and their microscopic structure can be good indicators of the response of the intestinal tract to active substances in feeds (Viveros, *et al.*, 2011). In this study, cocktail enzyme supplementation increased the villus height and crypt depth of the bird's duodenum fed low protein-normal energy, however the villus height of the birds fed low protein diets were not different from the low energy diet with enzyme supplementation while there was an increase in the jejunum villus height, crypt depth, villus width and the muscular width of the birds fed low energy-normal protein diets when compared to the normal density diets. It is assumed that, an increased villus height is paralleled by an increased digestive and absorptive function of the intestine as a result of increased absorptive surface area, expression of brush border enzymes and nutrient transport systems. This agrees with the report of Caspary (1992) and Zijlstra*et al.*(1996) who reported an increased body weight gain with an increase villus height. Also, the increase in the jejunum villus height, crypt depth, villus width and the muscular width of the birds fed low energy-normal protein diets suggested the increase in the surface area of tissue to enhance the